WATER RESOURCES REVIEW for AUGUST 1976

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

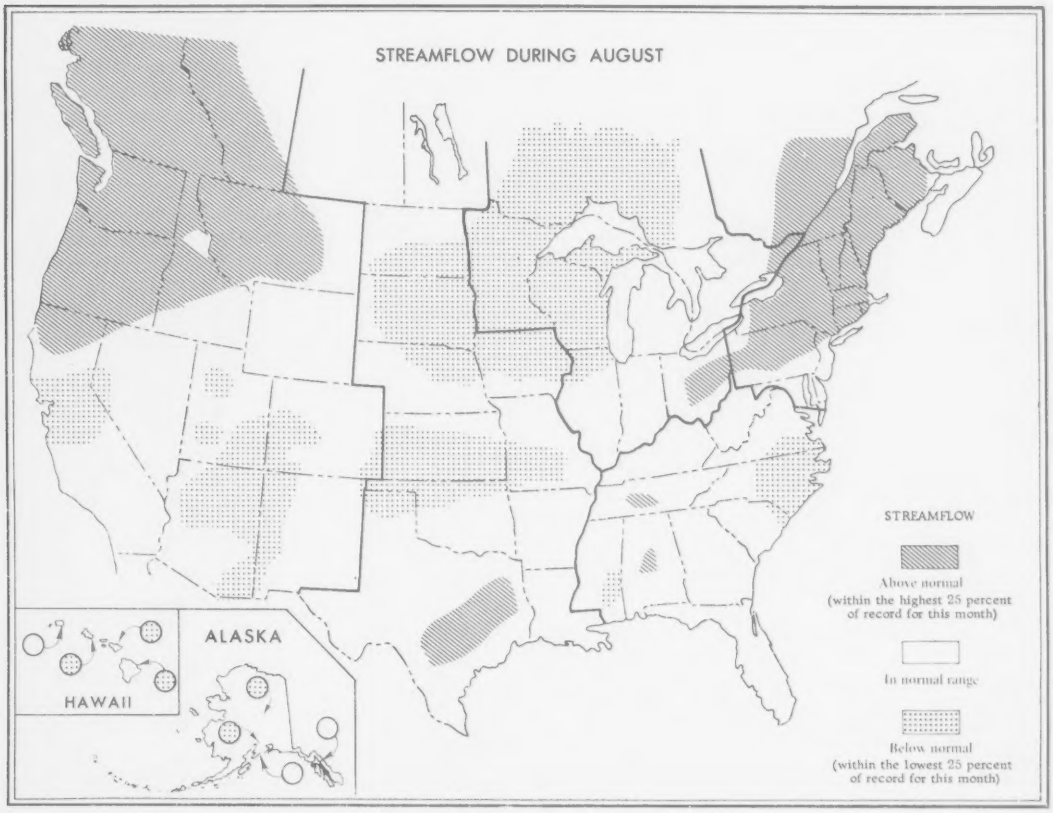
STREAMFLOW AND GROUND—WATER CONDITIONS

Streamflow decreased seasonally in most areas of southern Canada and the United States, but increased in parts of Quebec and in some northeastern and northwestern basins of the United States.

Flows remained in the above-normal range in large areas of the Northeast and Northwest. Below-normal flows persisted in the Midcontinent region and adjacent parts of the western Great Lakes region, as well as in south-central Canada and in several southeastern and southwestern States.

Monthly and daily mean flows were lowest of record in parts of Michigan, Minnesota, Iowa, Kansas, and Nebraska, and highest of record in parts of Idaho, Vermont, Maine, and Quebec.

Flooding occurred in Vermont, Massachusetts, and Washington.



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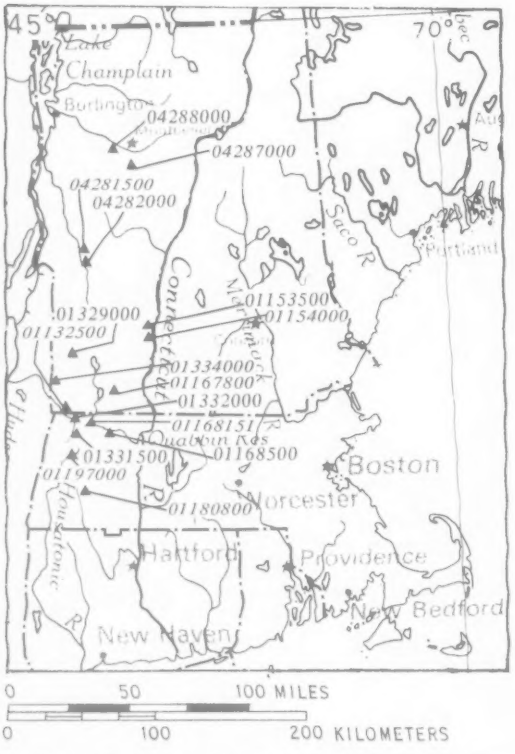
NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

Streamflow remained in the above-normal range in much of the region and increased into that range in Connecticut, Massachusetts, Rhode Island, New Brunswick, and southern Quebec. Monthly mean flows were highest of record in parts of Vermont, Maine, and Quebec.

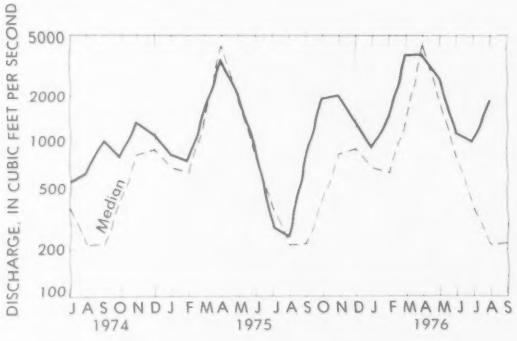
Rapid runoff from heavy rains associated with Hurricane Belle resulted in flooding along many streams in the New England States and southern Quebec. Peak flows at some gaging stations were highest of record and part of southern Vermont was declared a disaster area. Selected data on stages, discharges and gaging-station locations are given on the table on page 3 and accompanying map.



Locations of stream-gaging stations in Massachusetts and Vermont, described in table of peak stages and discharges on page 3.

Record-breaking monthly and daily mean discharges occurred at many index stations in the northern part of the region. For example, the August monthly mean discharges of 14,900 cfs on St. Francois River at Hemming Falls, Quebec (drainage area, 3,710 square miles), and 20,000 cfs on St. John River below Fish River, at Fort Kent, Maine (drainage area, 5,690 square miles) were highest in 50 years of record. The daily means of 80,000 cfs on August 12 at Fort Kent and 38,600 cfs on August 16 at Hemming Falls were 1.9 and 1.4 times, respectively, the previous August maximum dailys set in 1971. In central Maine, monthly mean flow at the index station, Piscataquis River near Dover-Foxcroft, decreased seasonally, and was about 8 times median for the month (in the above-normal range), with a new maximum daily of 4,800 cfs occurring on August 11.

Streamflow was in the above-normal range in the remaining New England States with monthly mean flows ranging from 2 to nearly 8.5 times the median. In central Vermont, the monthly mean of 1,826 cfs, and the daily mean of 12,700 cfs on the 10th, were the highest discharges for August in 61 years of record on White River at West Hartford. (See graph.)



Monthly mean discharge of White River at West Hartford, Vt. (Drainage area, 690 sq mi; 1,790 sq km)

In south-central New York, monthly mean discharge of Susquehanna River at Conklin was in the above-normal range for the 4th consecutive month. Downstream at Harrisburg, Pa., monthly mean flow also remained in the above-normal range. In the adjacent Delaware River basin, monthly mean flow of Delaware River at Trenton, N.J. decreased seasonally but remained in the above-normal range. In northern New York, monthly mean flows of Hudson River at Hadley, Mohawk River at Cohoes, and West Branch Oswegatchie River near Harrisville remained in the above-normal range. The daily mean of 1,190 cfs on August 15 at Harrisville was highest for the month since records began in July 1916.

In western Pennsylvania, streamflow decreased seasonally, and monthly mean discharge at Allegheny

River at Natrona (augmented by high carryover flow from July) increased into the above-normal range.

Ground-water level trends varied considerably from place to place. Levels went up in most of northern Maine and New Hampshire, southern Vermont, parts of southeastern and extreme western Massachusetts, and in the lower Hudson River valley of New York State. (See map on page 4.) Levels fell in many parts of central and southern New England as well as in southwestern New York State and much of Pennsylvania, New Jersey, Maryland, and Delaware. Monthend levels were above average in most of New England, New York, and Pennsylvania; were below average in central New Jersey; and generally were near average elsewhere. Levels in

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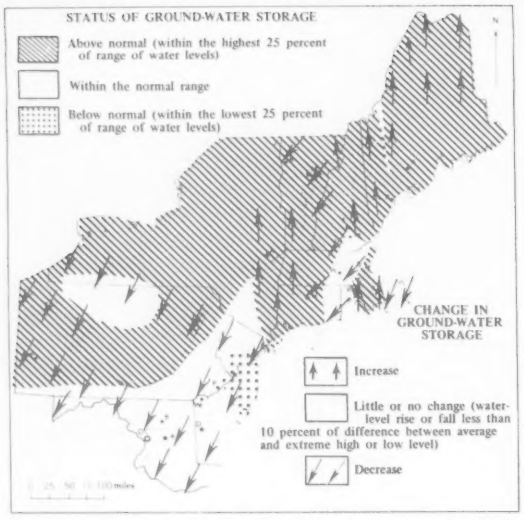
Provisional data; subject to revision

SUMMARY OF PEAK STAGES AND DISCHARGES IN MASSACHUSETTS AND VERMONT FOR THE FLOODS OF AUGUST 1976

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
CONNECTICUT RIVER BASIN											
01153500	Williams River at Brockways Mills, Vt.	103	1940–[b]	June 1, 1952	13.39	8,910	Aug. 10	15.85	[a]11,800	115.00	>50
01154000	Saxtons River at Saxtons River, Vt.	72.2	1940–[c]	June 30, 1973	13.26	7,510	10	14.06	[a]8,500	118.00	>50
01167800	Beaver Brook at Wilmington, Vt.	6.38	1963–	June 30, 1973	8.61	1,140	10	8.84	1,200	188.00	16
01168151	Deerfield River near Rowe, Mass.	254	1974–	May 25, 1974	7.14	2,050	10	14.79	16,400	64.6	.....
01168500	Deerfield River at Charlemont, Mass.	362	1913–	Sept. 21, 1938	20.17	56,300	10	11.90	20,300	56.1	6
01180800	Walker Brook near Becket Center, Mass.	3.01	1962–	Dec. 21, 1973	7.08	373	10	7.57	[a]500	166.00	36
HOUSATONIC RIVER BASIN											
01197000	E. Br. Housatonic R. at Coltsville, Mass.	57.1	1936–	Sept. 21, 1938	10.80	6,400	10	6.52	3,930	68.8	12
HUDSON RIVER BASIN											
01329000	Batten Kill at Arlington, Vt.	152	1928–	Mar. 18, 1936	11.3	11,100	10	9.37	5,990	39.4	12
01331500	Hoosic River at Adams, Mass.	46.3	1931–	Sept. 21, 1938	9.25	5,080	10	8.4	[a]2,700	58.3	18
01332000	N. Br. Hoosic River at North Adams, Mass.	39.0	1931–[d]	Sept. 21, 1938	12.05	8,950	10	12.24	8,450	217.00	32
01332500	Hoosic River near Williamstown, Mass.	132.00	1940–	Dec. 31, 1948	14.85	13,000	10	13.02	11,200	84.8	28
01334000	Walloomsac River near North Bennington, Vt.	111	1931–	Sept. 21, 1938	12.04	8,450	10	10.42	6,500	58.6	12
ST. LAWRENCE RIVER BASIN											
04281500	East Creek at Rutland, Vt.	51.1	1940–	June 3, 1947	20.3	36,500	10	5.22	2,120	41.5	25
04282000	Otter Creek at Center Rutland, Vt.	307	1928–	Sept. 22, 1938	13.45	13,700	11	12.70	9,420	30.7	10
04287000	Dog River at Northfield Falls, Vt.	76.1	1934–	June 30, 1973	11.57	10,600	10	8.56	5,930	77.9	8
04288000	Mad River near Moretown, Vt.	139	1910, 1927–	Nov. 3, 1927	19.4	23,000	10	13.47	13,400	96.4	19

[a] About.
[b] Flood of Sept. 1938 reached a stage of 22.7 ft; discharge not determined.
[c] Flood of Sept. 1938 reached a stage of 17.9 ft; discharge not determined.
[d] Flood in November 1927 reached a discharge of 9,980 cfs.


STATUS OF GROUND-WATER STORAGE
Above normal (within the highest 25 percent of range of water levels)
Within the normal range
Below normal (within the lowest 25 percent of range of water levels)
CHANGE IN GROUND-WATER STORAGE
Increase
Little or no change (water-level rise or fall less than 10 percent of difference between average and extreme high or low level)
Decrease

Map shows ground-water storage near end of August and change in ground-water storage from end of July to end of August.

some observation wells were at or near highest end-of-August levels in 12–34 years in Maine, Vermont, and New York, including the shallow observation well near Mercer in south-central Maine (period of record, 1945–76).

SOUTHEAST

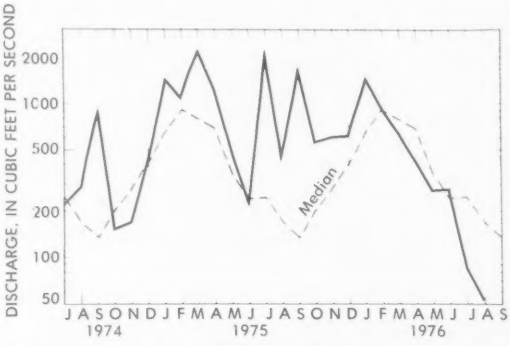
[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

Streamflow decreased throughout the region, except in northern Kentucky, and was below the normal range in parts of Mississippi, North Carolina, South Carolina, and Virginia. Flows remained in the above-normal range in western Tennessee and central Alabama.

In central North Carolina, monthly mean flow of Cape Fear River at William O. Huske Lock near Tarheel decreased sharply into the below-normal range and was only 27 percent of the August median. In the adjacent basin of Neuse River, mean flow at the index station near Clayton also decreased, was below the normal range, and was 28 percent of median. Agricultural drought conditions were reported to be very severe in parts of the State.

In South Carolina, monthly flow of Pee Dee River at Peedee also decreased sharply into the below-normal range and was only one-half of median for the month.

In southeastern Virginia, flow of Nottaway River near Stony Creek decreased seasonally, was one-third of the August median flow, and remained in the below-normal range. (See graph.) Elsewhere in the State, flows



Monthly mean discharge of Nottaway River near Stony Creek, Va. (Drainage area, 579 sq mi; 1,500 sq km)

continued to decrease and generally were about one-half of median.

In western Tennessee, monthly mean discharge in Duck River above Hurricane Mills continued to decrease seasonally but remained in the above-normal range for the 3d consecutive month.

In northern Kentucky, flow of Licking River at Catawba increased contraseasonally, and was 2 times the August median, but remained in the normal range.

Ground-water levels continued to decline in most of the region. Notable exceptions included the Piedmont of Georgia, where levels in many wells rose about ½ foot in response to heavy rainfall, and in southeastern Florida, where seasonal rainfall caused levels to rise 0.1 foot to nearly 2 feet. In Mississippi, the sharp declines experienced since early spring, by wells screened in the Sparta Sand in the Jackson area, continued, and record lows occurred in some of the wells. In Kentucky, despite declines in water level in the two principal observation wells, new August highs were recorded, reflecting the high levels attained in late spring and early summer. In the heavily-pumped Savannah area of coastal Georgia, levels in and near the center of pumping ranged from 2 to 5 feet lower than last month and were from 3 to 7 feet lower than last year. In the outlying area, levels were slightly lower than last month and about 3 feet lower than last year. Levels in many wells in the Savannah area reached an alltime low. In the Brunswick area of Georgia, levels in and near the center of pumping ranged from 2 to 5 feet higher than last month but were from 5 to 10 feet lower than last year. In the outlying area, levels were from 1 to 3 feet higher than last month and ranged from slightly lower to 3 feet lower than last year. Water levels reflected reduced pumping by one of the large industries in the area during last year, as well as a two-week shutdown during last month by one of the major water users.

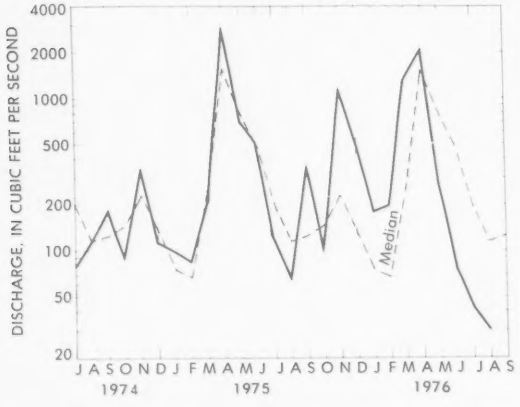
WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

Streamflow decreased seasonally throughout the region and remained in the below-normal range in Minnesota, Wisconsin, northern Michigan, and southern Ontario, and decreased into that range in northern Illinois. Flows remained above the normal range in parts of Ohio. Record low monthly and daily discharges occurred on Michigan's Upper Peninsula.

In Michigan's Upper Peninsula, monthly mean discharge at the index station, Sturgeon River near Sidnaw, was in the below-normal range for the 4th consecutive month and only 12 percent of median. The monthly mean discharge of 7.46 cfs and the daily mean of 4.0 cfs on August 25 were lowest for any month during the 36-year period of record.

Runoff in Wisconsin was below the normal range where about a 4-inch rainfall shortage is reported. Monthly mean flow at the index station, Jump River at Sheldon, decreased seasonally, was 26 percent of median, and remained in the below-normal range for the 4th consecutive month. (See graph.)



Monthly mean discharge of Jump River at Sheldon, Wis. (Drainage area, 574 sq mi; 1,487 sq km)

Streamflow at all index stations in Minnesota was in the below-normal range and less than 20 percent of median. For example, the monthly mean flow of 34.5 cfs in Crow River at Rockford (drainage area, 2,520 square miles) was lowest for August in 51 years of record and was only 19 percent of median and record low for the 2d consecutive month.

In southern Ontario, monthly mean discharge in Missinaibi River at Mattice and English River at Umfreville decreased seasonally and remained in the below-normal range and were about one-half of median.

Flows in central Ohio were in the above-normal range and about 2 times median.

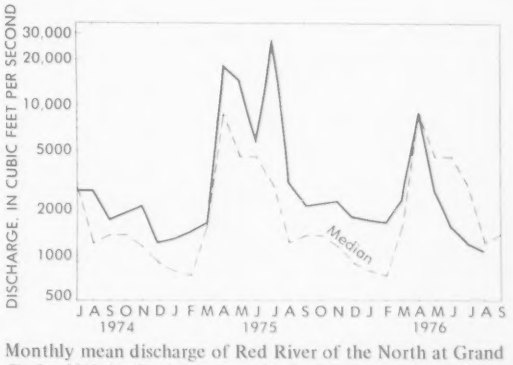
Ground-water levels declined in most of the region but rose slightly in northeastern Ohio. Monthend levels were near average in Ohio, Michigan, and Wisconsin; and remained below average in Minnesota. The level in the 32-foot deep observation well at Hanska in south-central Minnesota was the lowest end-of-August level ever recorded in the past 32 years. In the heavily pumped Minneapolis-St. Paul, Minn., area, artesian levels continued to decline and remained below average.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

Streamflow decreased seasonally in most parts of the region but increased in western Nebraska and northern Missouri. Flows remained below the normal range in parts of Iowa, Kansas, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas. Monthly mean flows were lowest of record for August at some index stations in Iowa, Kansas, and Nebraska.

In North Dakota, drought conditions prevailed across the southeastern two-thirds of the State where nearly all of the smaller streams have ceased flowing. Flow of the Cannonball River at Breien was only 2 percent of the median for the month and was nonexistent at monthend. In eastern North Dakota, monthly mean flow of Red River of the North at Grand Forks decreased seasonally, but was in the normal range as a result of runoff from scattered showers at midmonth. (See graph.)



Monthly mean discharge of Red River of the North at Grand Forks, N.Dak. (Drainage area, 30,100 sq mi; 78,000 sq km)

(Continued on page 7.)

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations above mean sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie, 157; Ontario, 1.22.)

Lake	August 31, 1976	Monthly mean, August		August		
		1976	1975	Average 1900–75	Maximum (year)	Minimum (year)
Superior (Marquette, Mich.)	601.18	601.22	601.40	601.00	602.02 (1950)	599.15 (1926)
Michigan and Huron (Harbor Beach, Mich.)	580.12	580.28	580.32	578.64	580.99 (1973)	575.97 (1964)
St. Clair (St. Clair Shores, Mich.)	575.35	575.56	575.46	573.72	576.03 (1973)	571.60 (1934)
Erie (Cleveland, Ohio)	572.45	572.59	572.36	570.73	573.03 (1973)	568.36 (1934)
Ontario (Oswego, N.Y.)	245.90	246.29	245.01	245.13	247.45 (1947)	242.26 (1934)

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	August 31, 1976	August 31, 1975	Reference period 1904–75		
			August average, 1904–75	August maximum (year)	August minimum (year)
Elevation in feet above mean sea level:	4,200.70	4,200.45	4,198.0	4,204.1 (1923)	4,191.65 (1963)

LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1975): 102.1 (1869). Alltime low (1963–1975): 92.17 (1941).	August 31, 1976	August 31, 1975	Reference period 1939–75		
			August average, 1939–75	August max. daily (year)	August min. daily (year)
Elevation in feet above mean sea level:	97.72	94.67	94.96	97.84 (1972)	93.39 (1949)

FLORIDA

Site	August 1976		July 1976	August 1975
	Discharge, in cfs	Percent of normal	Discharge, in cfs	Discharge, in cfs
Silver Springs near Ocala (northern Florida)	730	93	760	640
Miami Canal at Miami (southeastern Florida)	223	71	171	150
Tamiami Canal outlets, 40-mile bend to Monroe	395	101	426	154

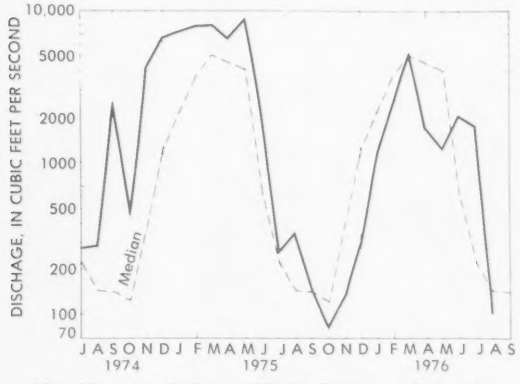
(Continued from page 5.)

In South Dakota, monthly mean flows at both index stations were less than 20 percent of median and in the below-normal range. Similarly, in eastern Nebraska, the monthly mean discharge of 119 cfs, in Elkhorn River at Waterloo, was only 19 percent of median and was a record low for August since records began in September 1928.

Streamflow continued to decrease in Iowa and was generally in the below-normal range; the northwestern part of the State experienced a serious drought. For example, the August monthly mean discharge of 80 cfs on Des Moines River at Fort Dodge (drainage area, 4,190 square miles), was lowest in 45 years of record and only 22 percent of median.

In western Kansas, the monthly mean discharge of 2.82 cfs at the index station, Saline River near Russell (drainage area, 1,502 square miles) was lowest for the month since records began in October 1945.

In southern Arkansas, flow decreased sharply in Saline River at Rye from July, when the flow was 8 times median, to 106 cfs and was in the normal range. (See graph.)



Monthly mean discharge of Saline River near Rye, Ark. (Drainage area, 2,062 sq mi; 5,340 sq km)

In the southern part of the region, streamflow remained in the above-normal range in some coastal basins in Texas; monthly mean discharges were about 3 times median.

In south-central Manitoba, monthly mean discharge of Waterhen River below Waterhen Lake also decreased seasonally and was in the normal range. The level of Lake Winnipeg at Gimli averaged 713.93 feet above mean sea level, 2.93 feet below the August 1975 level, and 0.65 feet lower than last month.

Ground-water levels declined seasonally in most of the region, including North Dakota, Iowa, Nebraska, Kansas, Arkansas, and in most of the major aquifers in Louisiana. However, levels rose in Louisiana in the "2,000-foot sand" at Baton Rouge and in the Chicot aquifer in the southwestern part of the State; levels in the Chicot aquifer have recovered more than 13 feet since pumping for rice irrigation decreased two months ago. Monthend levels in southeastern North Dakota were at or near lowest for end of August in at least 13 years of record as a result of the persistent drier-than-normal conditions. In northwestern Kansas at Colby (Thomas County), the water level in a key observation well in the heavily-pumped High Plains area was at an alltime low for the 29-year period of record. Monthend levels in Iowa ranged from substantially below average in the east to slightly above average in the south. In Nebraska, monthend levels were generally below long-term average levels. In Texas, levels rose in the Edwards Limestone at Austin; but declined in the Edwards Limestone at San Antonio, in the Evangeline aquifer at Houston, and in the bolson deposits at El Paso. Monthend levels were above average at Austin and San Antonio, and below average at El Paso (lowest of record for August) and Houston. Levels were at an alltime low in the Ogallala Formation at Plainview.

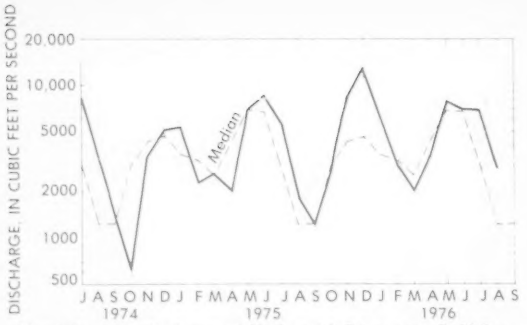
WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

Streamflow decreased seasonally in most of the region and was variable in Arizona, California, Idaho, New Mexico, Oregon, and Washington. Flows remained in the below-normal range in central California and central Colorado and increased into that range in parts of Arizona, New Mexico, and Utah. Above-normal flows occurred in Alberta, British Columbia, northern California, Idaho, Montana, Oregon, and Washington. Flooding occurred in Washington.

Severe flooding occurred in parts of Lincoln and Douglas counties, in north-central Washington, on August 6, as a result of runoff from intense rains of 2 to 3 hours duration. Peak discharges at many crest-stage gage sites were greater than the discharge of a 100-year flood. Rains of 1 to 2 hours duration on August 3 and again on August 15 struck southeastern Washington in the vicinity of Asotin County and produced flood flows of similar magnitude and the greatest since 1896 as reported by residents in the area. Typical of the statewide above-normal trend in streamflow was Skykomish River near Gold Bar where flow was above median for the 2d consecutive month. (See graph on page 8.)

Streamflow in Montana and northern Idaho decreased seasonally and remained in the above-normal range at

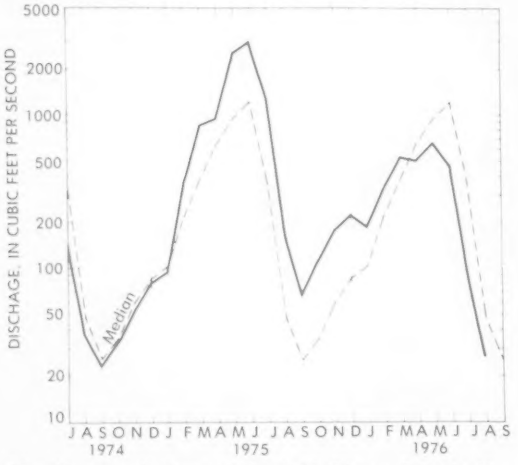


Monthly mean discharge of Skykomish River near Gold Bar, Wash. (Drainage area, 535 sq mi; 1,386 sq km)

most index stations. Similarly, in Alberta and British Columbia, monthly mean discharge at all index stations was above median and in the above-normal range. In central Idaho, the monthly mean flow of 8,990 cfs on Salmon River at White Bird was 1.7 times the August median, in the above-normal range, and highest for the month in 65 years of record.

In California, runoff was in the above-normal range in the extreme north coastal area but remained in the below-normal range in streams from the central Sierra Nevada. Flow of North Fork American River at North Fork Dam increased slightly but remained in the below-normal range for the 8th consecutive month.

Flow in Nevada as measured at the index station, Humboldt River at Palisade, decreased seasonally to about one-half the August median but was within the normal range. (See graph.)



Monthly mean discharge of Humboldt River at Palisade, Nev. (Drainage area, 5,010 sq mi; 12,980 sq km)

Monthly mean flows in Arizona and Utah were generally in the below-normal range.

Contents of major reservoirs in northern California were further reduced to only 67 percent of average and 58 percent of last year. The net decrease in storage in the Colorado River Storage Project was 458,460 acre-feet during the month.

Ground-water levels rose in observation wells in northern and southeastern Utah (Logan, Holladay, and Blanding), southern Idaho (Rupert-Minidoka area), and western Nevada (Truckee Meadows); rose or stayed about the same in southern Arizona; and generally declined in Montana, northwestern and eastern Washington (Sumas and Spokane), northern Idaho (Rathdrum Prairie area), southwestern and southeastern Idaho (Meridian and Atomic City), northern and east-central Nevada (Paradise and Steptoe) and in central Utah (Flowell). Monthend levels were near average in Montana, and were above average in northwestern and eastern Washington and in northern and east-central Idaho (highest August level of record at Steptoe). Levels continued below average in southern California, and were below average also in north-central and south-central Utah (Holladay and Flowell), and in western Nevada (Truckee Meadows). In southern Idaho, the level was above average in the well penetrating the sand and gravel aquifer in the Boise Valley, and levels were below average in the key wells representative of the Snake Plain near Atomic City and in the Rupert-Minidoka area. In southern New Mexico, levels declined and were below average in the shallow aquifer of the southern Roswell basin and the artesian aquifer of the Pecos Valley (alltime low). In southern Arizona, the level in the Tucson No. 2 well was lowest of record for August, and in the well at Elfrida was at an alltime low; at Higley, in the western part of Salt River valley, the level in the observation well was highest of record for August.

ALASKA

Streamflow generally decreased seasonally in the south coastal basins and was in the normal range. However, monthly mean discharge at the index station, Chena River at Fairbanks, although increasing seasonally, remained in the below-normal range for the 3d consecutive month as a result of below-normal rainfall and above-normal temperatures.

Ground-water levels in the Anchorage area remained steady both in the alluvial aquifers and in outlying parts of the deep confined aquifers. However, in the heavily pumped area of central Anchorage, levels in the deep aquifers rose 3 to 9 feet as a result of a substantial reduction in pumping.

HAWAII

Streamflow generally decreased and was below the normal range. On the island of Maui, monthly mean flow of Honopou Stream near Huelo decreased seasonally and remained below the normal range for the 3d consecutive month. On Oahu, flow at the index station, Kalihi Stream near Honolulu, also decreased seasonally, was only one-fourth of the August median flow, and was below the normal range. In the eastern part of the island of Hawaii, flow of Waiakea Stream near Mountain View increased seasonally but was only one-half of median and was in the below-normal range.

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF AUGUST 1976

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of July 1976	End of Aug. 1976	End of Aug. 1975	Average for end of Aug.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	74	64	47	48	223,400 (a)
QUEBEC					
Allard (P)	88	90	82	104	280,600 ac-ft
Gouin (P)	84	90	76	102	6,954,000 ac-ft
MAINE					
Seven reservoir systems (MP)	92	94	64	58	178,500 mcf
NEW HAMPSHIRE					
First Connecticut Lake (P)	86	85	88	84	3,330 mcf
Lake Francis (FPR)	79	77	81	83	4,326 mcf
Lake Winnipesaukee (PR)	95	87	87	74	7,200 mcf
VERMONT					
Harriman (P)	78	72	75	70	5,060 mcf
Somerset (P)	88	80	86	77	2,500 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	83	82	83	78	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	89	79	73	71	34,270 mcf
Indian Lake (FMP)	100	100	102	71	4,500 mcf
New York City reservoir system (MW)	93	90	91	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	95	89	100	75	27,730 mg
PENNSYLVANIA					
Allegheny (FPR)	48	44	44	40	51,400 mcf
Pymatuning (FMR)	91	89	93	86	8,191 mcf
Raystown Lake (FR)	67	67	64	48	33,190 mcf
Lake Wallenpaupack (PR)	75	68	67	64	6,875 mcf
MARYLAND					
Baltimore municipal system (M)	98	95	99	88	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	94	93	87	88	12,580 mcf
Narrows (Badin Lake) (P)	97	96	93	99	5,617 mcf
High Rock Lake (P)	82	80	82	74	10,230 mcf
SOUTH CAROLINA					
Lake Murray (P)	92	87	82	71	70,300 mcf
Lakes Marion and Moultrie (P)	85	79	84	67	81,100 mcf
SOUTH CAROLINA—GEORGIA					
Clark Hill (FP)	80	75	79	66	75,360 mcf
GEORGIA					
Burton (PR)	94	91	88	86	104,000 ac-ft
Sinclair (MPR)	84	85	88	86	214,000 ac-ft
Lake Sidney Lanier (FMPR)	64	60	63	58	1,686,000 ac-ft
ALABAMA					
Lake Martin (P)	96	93	96	85	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	56	44	41	47	1,156,000 cfsd
Douglas Lake (FPR)	73	45	28	47	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	90	78	59	68	510,300 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	63	52	49	53	1,452,000 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	90	72	50	68	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	79	69	75	75	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	51	31	48	65	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	25	21	41	35	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	98	94	102	.....	22,640,000 ac-ft
SOUTH DAKOTA					
Angostura (I)	72	65	74	77	127,600 ac-ft
Bell Fourche (I)	50	16	38	39	185,200 ac-ft
Lake Francis Case (FIP)	78	77	76	77	4,834,000 ac-ft
Lake Oahe (FIP)	86	84	99	.....	22,530,000 ac-ft

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of July 1976	End of Aug. 1976	End of Aug. 1975	Average for end of Aug.	Normal maximum
	Percent of normal maximum				
MIDCONTINENT REGION—Continued					
SOUTH DAKOTA—Continued					
Lake Sharpe (FIP)	103	103	99	98	1,725,000 ac-ft
Lewis and Clarke Lake (FIP)	92	95	95	96	477,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	69	64	70	68	1,948,000 ac-ft
OKLAHOMA					
Eufaula (FPR)	88	79	93	78	2,378,000 ac-ft
Keystone (FPR)	102	75	93	89	661,000 ac-ft
Tenkiller Ferry (FPR)	101	93	102	90	628,200 ac-ft
Lake Altus (FIMR)	82	59	96	47	134,500 ac-ft
Lake O'The Cherokees (FPR)	94	85	84	83	1,492,000 ac-ft
OKLAHOMA—TEXAS					
Lake Texoma (FMPRW)	99	92	100	92	2,722,000 ac-ft
TEXAS					
Bridgeport (IMW)	90	84	100	43	386,400 ac-ft
Canyon (FMR)	100	93	94	64	385,600 ac-ft
International Amistad (FIMPW)	100	100	100	65	3,497,000 ac-ft
International Falcon (FIMPW)	100	93	89	62	2,667,000 ac-ft
Livingston (IMW)	100	97	99	73	1,788,000 ac-ft
Possum Kingdom (IMPRW)	92	89	95	100	569,400 ac-ft
Red Bluff (PI)	25	21	43	22	307,000 ac-ft
Toledo Bend (P)	100	90	92	81	4,472,000 ac-ft
Twin Buttes (FIM)	92	88	95	11	177,800 ac-ft
Lake Kemp (IMW)	71	61	80	85	268,000 ac-ft
Lake Meredith (FMW)	38	38	48	41	821,300 ac-ft
Lake Travis (FIMPRW)	100	94	91	73	1,144,000 ac-ft
THE WEST					
WASHINGTON					
Ross (PR)	99	99	100	94	1,052,000 ac-ft
Franklin D. Roosevelt Lake (IP)	97	97	99	98	5,232,000 ac-ft
Lake Chelan (PR)	97	99	99	94	676,100 ac-ft
Lake Cushman	103	100	102	97	359,500 ac-ft
Lake Merwin (P)	106	106	106	102	246,000 ac-ft
IDAHO					
Boise River (4 reservoirs) (FIP)	75	65	68	58	1,235,000 ac-ft
Coeur d'Alene Lake (P)	99	99	100	72	238,500 ac-ft
Pend Oreille Lake (FP)	100	99	100	100	1,561,000 ac-ft
IDAHO—WYOMING					
Upper Snake River (8 reservoirs) (MP)	68	60	70	56	4,401,000 ac-ft
WYOMING					
Boysen (FIP)	86	92	94	87	802,000 ac-ft
Buffalo Bill (IP)	103	90	90	90	421,300 ac-ft
Keyhole (F)	75	73	72	42	199,900 ac-ft
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	71	63	67	46	3,056,000 ac-ft
COLORADO					
John Martin (FIR)	0	0	0	18	364,400 ac-ft
Taylor Park (IR)	81	72	98	78	106,200 ac-ft
Colorado–Big Thompson project (I)	68	59	82	60	722,600 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	83	82	85	.....	31,280,000 ac-ft
UTAH—IDAHO					
Bear Lake (IPR)	89	86	91	61	1,421,000 ac-ft
CALIFORNIA					
Folsom (FIP)	53	47	80	69	1,000,000 ac-ft
Hetch Hetchy (MP)	50	43	87	69	360,400 ac-ft
Isabella (FIR)	17	13	37	30	551,800 ac-ft
Pine Flat (FI)	27	20	43	40	1,014,000 ac-ft
Clair Engle Lake (Lewiston) (P)	76	70	90	83	2,438,000 ac-ft
Lake Almanor (P)	59	60	91	54	1,036,000 ac-ft
Lake Berryessa (FIMW)	70	67	89	82	1,600,000 ac-ft
Millerton Lake (FI)	49	38	35	41	503,200 ac-ft
Shasta Lake (FIPR)	39	31	86	73	4,377,000 ac-ft
CALIFORNIA—NEVADA					
Lake Tahoe (IPR)	54	48	85	64	744,600 ac-ft
NEVADA					
Rye Patch (I)	76	76	105	.....	157,200 ac-ft
ARIZONA—NEVADA					
Lake Mead and Lake Mohave (FIMP)	78	77	76	71	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	2	0	8	12	1,073,000 ac-ft
Salt and Verde River system (IMPR)	56	51	55	37	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	27	24	28	81	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	18	14	19	24	2,539,000 ac-ft

[a]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage)

DISSOLVED SOLIDS AND WATER TEMPERATURES FOR AUGUST AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	August data of following calendar years	Stream discharge during month	Dissolved-solids concentration during month[a]		Dissolved-solids discharge during month[a]			Water temperature during month		
			Mean (cfs)	Minimum (mg/l)	Maximum (mg/l)	Mean	Minimum	Maximum	Mean, in °C	Minimum, in °C	Maximum, in °C
						(tons per day)					
	NORTHEAST										
01463500	Delaware River at Trenton, N.J.	1976*	8,070	.....	.....	.....	.....	.....	25.0 (77°F)	22.5 (72°F)	28.0 (82°F)
	(Morrisville, Pa.)	1945–75	6,421 [4,268[b]]	67 (Aug.1–10,1945)	158 (Aug. 24, 1967)	.....	505 (Aug. 21, 1965)	21,500 (Aug.15–20,1955)	.....	17.5 (64°F)	31.5 (88°F)
04264331	St. Lawrence River at Cornwall, Ontario, near	1976	326,000	166	167	146,000	141,000	153,000	20.0 (68°F)	19.0 (66°F)	20.5 (69°F)
	Massena, N.Y. (streamflow station formerly at Ogdensburg, N.Y.)	1966–75	278,000 [252,000[b]]	.....	.....	.....	.....	.....	22.0 (72°F)	19.0 (66°F)	24.5 (76°F)
	SOUTHEAST										
07289000	Mississippi River at Vicksburg, Miss	1976	280,000 [317,600[b]]	238	260	198,000	163,000	226,000	28.5 (84°F)	27.5 (82°F)	30.5 (87°F)
	WESTERN GREAT LAKES REGION										
03612500	Ohio River at lock and dam 53, near Grand Chain, Ill.	1976	119,900	135	195	.....	31,300	93,200	.....	26.0 (79°F)	29.5 (85°F)
	(25 miles west of Paducah, Ky.; streamflow station at Metropolis, Ill.)	1955–75,	129,200 [102,200[b]]	128 (Aug. 18, 1963)	321 (Aug. 26, 1969)	.....	20,300 (Aug. 4, 1965)	246,000 (Aug. 1, 1958)	.....	17.0 (62°F)	30.5 (87°F)
	MIDCONTINENT										
06934500	Missouri River at Hermann, Mo. (60 miles west of St. Louis, Mo.)	1976	46,800 [55,620[b]]	360	433	51,800	46,900	58,400	27.0 (80°F)	25.0 (77°F)	29.5 (85°F)
	WEST										
14128910	Columbia River at Warrendale, Oreg.	1976	227,700	71	78	46,300	28,700	52,500	19.0 (66°F)	18.5 (66°F)	19.5 (67°F)
	(30 miles east of Portland, Oreg.; streamflow station at The Dalles, Oreg.)	1967–75	145,300 [153,200[b]]	.....	.....	.....	.....	.....	.....	18.5 (66°F)	22.5 (72°F)

[a] Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b] Median of monthly values for 30-year reference period, water years 1941–70, for comparison with data for current month.
*Dissolved-solids monitoring station temporarily out of operation (August 1976).

PERIODIC REPORTS ON GROUND-WATER LEVELS IN THE UNITED STATES, 1935–74

Publication of records of water levels in the United States in the annual series of water-supply papers was begun by the Geological Survey in 1935. From 1935 through 1939, one volume per year was issued—Water-Supply Papers 777, 817, 840, 845, and 886, respectively. For the years 1940 through 1955, the nationwide data were subdivided into six regions, and thus six volumes of water-level records were published for each of those years. Since 1955, the period of time covered in each volume has been increased, so that now each regional volume contains five years of water-level data.

Year, regions (groups of States), and report numbers of annual and five-year reports on water levels in observation wells in the United States, 1935–74

Calendar year	Water-Supply Paper number					
	Northeastern States (part 1)	Southeastern States (part 2)	North-central States (part 3)	South-central States (part 4)	Northwestern States (part 5)	Southwestern States (part 6)
(States in region:)	Conn. Del. Ind. Maine Mass. Mich. N. H. N. J. N. Y. Ohio Pa. R. I. Vt.	Ala. Fla. Ga. Ky. Md. Miss. N.C. S. C. Tenn. Va. W. Va.	Ill. Iowa Kans. Minn. Mo. Nebr. N. Dak. S. Dak. Wis.	Ark. La. Okla. Tex.	Alaska Colo. Idaho Mont. Oreg. Utah Wash. Wyo.	Ariz. Calif. Hawaii Nev. N. Mex.
1935	777	777	777	777	777	777
1936	817	817	817	817	817	817
1937	840	840	840	840	840	840
1938	845	845	845	845	845	845
1939	886	886	886	886	886	886
1940	906	907	908	909	910	911
1941	936	937	938	939	940	941
1942	944	945	946	947	948	949
1943	986	987	988	989	990	991
1944	1016	1017	1018	1019	1020	1021
1945	1023	1024	1025	1026	1027	1028
1946	1071	1072	1073	1074	1075	1076
1947	1096	1097	1098	1099	1100	1101
1948	1126	1127	1128	1129	1130	1131
1949	1156	1157	1158	1159	1160	1161
1950	1165	1166	1167	1168	1169	1170
1951	1191	1192	1193	1194	1195	1196
1952	1221	1222	1223	1224	1225	1226
1953	1265	1266	1267	1268	1269	1270
1954	1321	1322	1323	1324	1325	1326
1955	1404	1405	1406	1407	1408	1409
1956	1537	1538	1456	1549	1760	1770
1957	1537	1538	1781	1549	1760	1770
1958	1782	1538	1781	1549	1760	1770
1959	1782	1803	1781	1549	1760	1770
1960	1782	1803	1781	1824	1760	1770
1961	1782	1803	1781	1824	1845	1855
1962	1782	1803	1976	1824	1845	1855
1963	1977	1803	1976	1824	1845	1855
1964	1977	1978	1976	1824	1845	1855
1965	1977	1978	1976	1979	1845	1855
1966	1977	1978	1976	1979	1980	2010
1967	1977	1978	2090	1979	1980	2010
1968	2140	1978	2090	1979	1980	2010
1969	2140	2171	2090	1979	1980	2010
1970	2140	2171	2090	2172	1980	2010
1971	2140	2171	2090	2172	(a)	(a)
1972	2140	2171	(a)	2172	(a)	(a)
1973	(a)	2171	(a)	2172	(a)	(a)
1974	(a)	(a)	(a)	2172	(a)	(a)

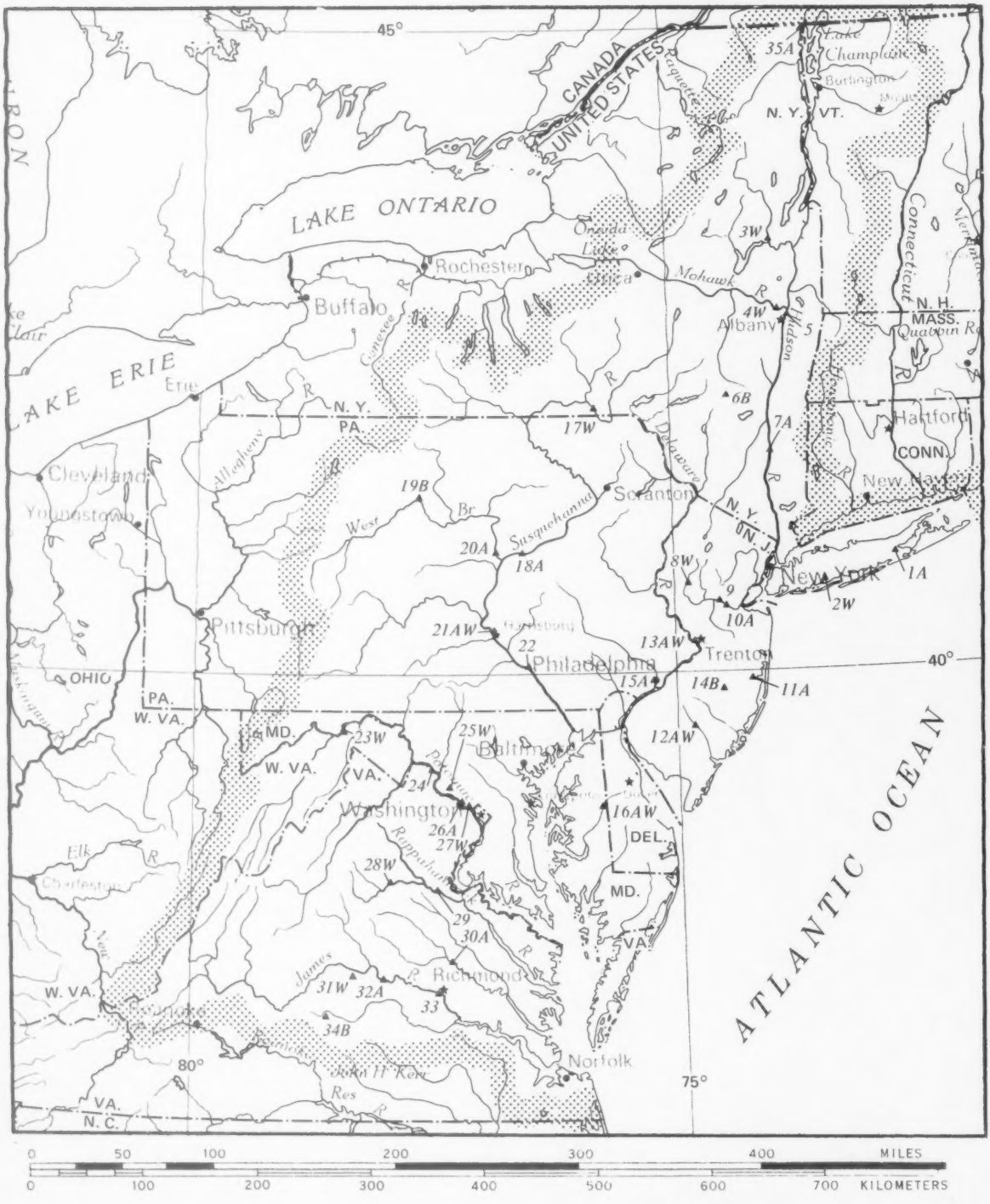
[a]Report in preparation.

Beginning in 1956, water-level data from only a *basic network* of observation wells have been published. This basic network consists of observation wells located insofar as possible where the most significant data can be obtained from the fewest wells in the most important aquifers. In some States the basic network forms the skeletal index of a more comprehensive observation-well program carried out in cooperation with State and other governmental agencies. Publications that contain substantial additional water-level data are listed as references in the 5-year volumes following the water-level data for each State. The table at left identifies the water-supply paper number of the report containing water-level records for a given year and also the regional classification of each State in this series of reports.

Water-supply papers are available for reference in many large public and university libraries and in the district offices of the U.S. Geological Survey. Water-supply papers still in print may be purchased from the U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 (check or money order payable to U.S. Geological Survey); or from Superintendent of Documents, Government Printing Office, Washington, DC 20402 (payable to Superintendent of Documents). The price of Water-Supply Paper 2171 is $2.45; and of Water-Supply Paper 2172 is $2.50.

In the collection of water-level data for the observation-well program, the principal objective is to measure *changes* in water level accurately, rather than to determine the absolute position of the water surface. Because the measurements are made in many types of wells, under varying conditions of access and at different temperatures, neither the method of measurement nor the equipment can be completely uniform. At each observation well, however, the best possible combination of measuring technique and equipment is used, and so long as it is not changed, the measurements at each well will be consistent. Water-level measurements are given in feet with reference to either mean sea level or land-surface datum. Mean sea level is the datum plane on which the national network of water levels is based; land-surface datum is a precise datum plane that is approximately at land surface at each well. If known, the altitude of the land-surface datum above mean sea level is given in the well description. Measurements of water levels in wells equipped with recording gages are given for every fifth day and the last day of each month.

MID-ATLANTIC WATER RESOURCES REGION



The Mid-Atlantic Region is region 2 of the 21 water resources regions defined by the U.S. Water Resources Council. The regional boundary, shown above as the inner edge of the shaded border, is along river-basin divides. Region 2 has a total area of about 108,000 square miles (280,000 sq km), and includes the Lake Champlain basin (U.S. part), and the Hudson, Delaware, Susquehanna, Potomac, and James River basins.

This is the first of a series of regional reports, which will appear periodically in the Water Resources Review, prepared by J.C. Kammerer.

SELECTED DATA FOR SOME KEY STREAM STATIONS IN THE MID-ATLANTIC REGION

The stream stations listed below include, for this region, all Level I Accounting Network water-quality sites implemented by the Geological Survey in fiscal years 1973–75, all Geological Survey hydrologic bench-mark stream-gaging stations, all river stations of the International Hydrological Decade (IHD, 1965–74), and all index and large-river stations that are used each month in compiling the Water Resources Review.

The map number identifies Accounting sites by "A," hydrologic bench-mark stations by "B," and Water Resources Review stations by "W." The IHD stations are those with map numbers 5, 13AW, 21AW, 27W, and 33. Of the 14 Accounting ("A") stations, radiochemical sampling is carried out at stations 7A, 13AW, 21AW, and 26A; and pesticide sampling at stations 7A, 10A, 13AW, 16AW, 20A, 21AW, 30A, and 35A.

Streams are listed from north to south (except Richelieu River) and in downstream order within a basin.

Station number, name, and drainage area of 36 sites

Number on map	USGS station number	Site	Drainage area (sq mi)	Average discharge: years of record (cfs)
1A	01304500	Peconic River at Riverhead, N.Y.	75	34.9/33
2W	01309500	Massapequa Creek at Massapequa, N.Y.	38	11.3/38
3W	01318500	Hudson River at Hadley, N.Y.	1,664	2,853/54
4W	01357500	Mohawk River at Cohoes, N.Y.	3,456	5,630/50
5	01358000	Hudson River at Green Island, N.Y.	8,090	13,290/29
6B	01362198	Esopus Creek at Shandaken, N.Y.	59.5	135/12
7A	01372043	Hudson River near Poughkeepsie, N.Y.	11,700	.....
8W	01396500	South Branch Raritan River near High Bridge, N.J.	65.3	119/57
9	01403060	Raritan River below Calco Dam, at Bound Brook, N.J.	785	1,256/36
10A	01404100	Raritan River near South Bound Brook, N.J.	862	.....
11A	01408500	Toms River near Toms River, N.J.	124	215/47
12AW	01411000	Great Egg Harbor River at Folsom, N.J.	56.3	86.4/50
13AW	01463500	Delaware River at Trenton, N.J.	6,780	11,630/63
14B	01466500	McDonalds Branch in Lebanon State Forest, N.J.	2.31	2.33/22
15A	01474500	Schuylkill River at Philadelphia, Pa.	1,893	2,903/44
16AW	01491000	Choptank River near Greensboro, Md.	113	131/27
17W	01503000	Susquehanna River at Conklin, N.Y.	2,232	3,566/62
18A	01540500	Susquehanna River at Danville, Pa.	11,220	15,190/76
19A	01545600	Young Womans Creek near Renovo, Pa.	46.2	75.3/10
20A	01553500	West Branch Susquehanna River at Lewisburg, Pa.	6,847	10,600/36
21AW	01570500	Susquehanna River at Harrisburg, Pa.	24,100	34,200/85
22	01576000	Susquehanna River at Marietta, Pa.	25,990	36,290/44
23W	01610000	Potomac River at Paw Paw, W. Va.	3,109	3,196/37
24	01638500	Potomac River at Point of Rocks, Md.	9,651	9,296/80
25W	01645000	Seneca Creek at Dawsonville, Md.	101	97.9/45
26A	01645500	Potomac River at Great Falls, Md.	11,430	.....
27W	01646500	Potomac River near Washington, D.C.	11,560	11,190/45
28W	01667500	Rapidan River near Culpeper, Va.	472	518/45
29	01668000	Rappahannock River near Fredericksburg, Va.	1,596	1,644/68
30A	01673000	Pamunkey River near Hanover, Va.	1,081	987/34
31W	02030500	Slate River near Arvonia, Va.	226	229/49
32A	02035000	James River at Cartersville, Va.	6,257	7,046/77
33	02037500	James River near Richmond, Va.	6,758	7,483/41
34B	02038850	Holiday Creek near Andersonville, Va.	8.53	10.1/9
35A	04295000	Richelieu River (Lake Champlain) at Rouses Point, N.Y.	8,277	.....
(36)	.....	Richelieu River at Fryers Rapids, at Chambly, Quebec (30 miles north of site 35A)	8,510	11,500/37

Mean and extreme discharges at nine long-term stream-gaging stations

Number on map	Stream	Maximum discharge: month–year (cfs)	Minimum discharge: month–year (cfs)	Average discharge, 1941–70 (cfs)	Average discharge (1941–70) by months, expressed as percent of average discharge for entire 30-water-year period											
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					(percent)											
3W	Hudson	42,700/1–49	281/9–34	2,730	73	66	122	309	182	88	49	41	42	59	84	86
3W	Hudson*	.....	.....	2,710	71	69	113	328	179	86	48	41	39	52	83	91
4W	Mohawk	143,000/3–64	6/9–41	5,380	100	105	204	247	127	67	37	29	36	52	86	109
4W	Mohawk*	.....	.....	5,290	103	112	195	265	122	63	38	29	34	46	84	108
5	Hudson*	215,000/3–36	882/9–68	12,500	102	106	162	250	137	75	48	41	44	53	84	105
13AW	Delaware	329,000/8–55	1,180/10–63	11,300	105	112	175	190	127	76	57	55	44	50	88	103
15A	Schuylkill	103,000/6–72	0/at times	2,420	119	207	190	161	124	74	55	51	45	40	83	114
22	Susquehanna	1,080,000/6–72	618/9–32	35,100	109	119	218	222	151	77	39	31	26	38	75	86
27W	Potomac	484,000/3–36	121/9–66	10,100	121	153	225	176	132	78	46	47	35	49	53	89
33	James	313,000/6–72	10/66,68,70	5,820	132	165	210	165	116	65	42	57	40	49	58	103
(36)	Richelieu	43,700/6–47	1,410/8–41	10,700	72	70	105	227	195	150	87	55	46	52	67	74

*Averages shown on this line are for the period 1947–70 instead of 1941–70. Station 01358000 (site 5) was not established until February 1946.

Approximate drainage areas of principal river basins in the Mid-Atlantic Region (from U.S. Geological Survey Water-Supply Paper 1899–I):

Hudson River basin (including Mohawk River and Croton River basins) 13,400 sq mi (34,700 sq km)

Delaware River basin (including Schuylkill River basin) 11,400 sq mi (29,500 sq km)

Susquehanna River basin 27,500 sq mi (71,200 sq km)

Potomac River basin 13,700 sq mi (35,500 sq km)

James River basin 10,000 sq mi (25,900 sq km)

FLOW OF LARGE RIVERS DURING AUGUST 1976

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	August 1976					
				Monthly discharge (cfs)	Percent of median monthly discharge, 1941–70	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	20,000	576	+37	9,100	5,880	31
1–3185	Hudson River at Hadley, N.Y	1,664	2,791	2,556	234	-13	1,700	1,100	31
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	3,599	251	-34	.....	.....	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,360	7,654	179	-15	3,760	2,430	26
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	18,140	239	-16	10,500	6,790	31
1–6465	Potomac River near Washington, D.C.	11,560	[1]10,640	3,270	107	-23	1,600	1,030	31
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	788	27	-43	670	430	31
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	3,020	49	-63	2,780	1,800	26
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	5,318	85	-50	4,520	2,920	25
2–3205	Suwannee River at Branford, Fla	7,740	6,775	4,990	93	-45	4,530	2,930	27
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	13,900	98	-34	12,600	8,140	26
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	4,687	99	-28	3,450	2,230	27
2–4895	Pearl River near Bogalusa, La	6,630	8,533	2,397	87	-44	1,600	1,030	31
3–0495	Allegheny River at Natrona, Pa	11,410	[1]18,700	8,336	177	-3	4,060	2,620	30
3–0850	Monongahela River at Braddock, Pa.	7,337	[1]11,950	3,479	84	-38	2,450	1,580	30
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	3,610	86	-44	3,450	2,230	27
3–2345	Scioto River at Higby, Ohio	5,131	4,337	2,101	232	-25	942	608	26
3–2945	Ohio River at Louisville, Ky[2]	91,170	110,600	38,500	129	-40	29,900	19,300	26
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	6,908	81	-53	4,750	3,070	31
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[1]6,528	2,642	84	-53	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	6,150	4,142	1,380	63	-12	.....	.....	.....
02MC002 (4–2643.31)	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[3]	299,000	239,100	325,900	129	-7	316,000	204,000	31
050115	St. Maurice River at Grand Mere, Quebec.	16,300	24,900	26,600	166	+13	17,800	11,500	30
5–0825	Red River of the North at Grand Forks, N. Dak.	30,100	2,439	1,028	86	-14	950	610	31
5–3300	Minnesota River near Jordan, Minn	16,200	3,306	280	15	-29	207	134	27
5–3310	Mississippi River at St. Paul, Minn	36,800	[1]10,230	1,133	16	-54	689	445	26
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	1,198	42	-33	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	3,364	68	-10	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	2,017	73	-35	2,000	1,300	31
5–4745	Mississippi River at Keokuk, Iowa	119,000	61,210	19,167	50	-30	15,600	10,100	31
5–4855	Des Moines River below Raccoon River at Des Moines, Iowa.	9,879	3,796	371	24	-72	216	140	31
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	8,523	161	-57	4,950	3,200	31
6–9345	Missouri River at Hermann, Mo	528,200	78,480	46,810	84	-21	45,500	29,400	25
7–2890	Mississippi River at Vicksburg, Miss.[4]	1,144,500	552,700	280,800	88	-38	240,000	155,000	31
7–3310	Washita River near Durwood, Okla	7,202	1,379	126	35	-61	48	31	31
8–3130	Rio Grande at Otowi Bridge, near San Ildefonso, N.Mex.	14,300	1,530	570	68	-13	.....	.....	.....
9–3150	Green River at Green River, Utah	40,600	6,369	2,885	94	-36	3,000	1,900	31
11–4255	Sacramento River at Verona, Calif	21,257	18,370	12,600	146	+12	12,600	8,140	26
13–2690	Snake River at Weiser, Idaho	69,200	17,670	12,880	120	+30	13,400	8,660	27
13–3170	Salmon River at White Bird, Idaho	13,550	11,060	8,990	165	-45	9,180	5,930	27
13–3425	Clearwater River at Spalding, Idaho	9,570	15,320	3,651	102	-78	4,680	3,020	27
14–1057	Columbia River at The Dalles, Oreg.[5]	237,000	194,000	226,900	148	-5	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	7,849	139	+3	8,330	5,380	27–31
15–5155	Tanana River at Nenana, Alaska	25,600	24,040	55,326	106	+17	41,300	26,700	31
8MF005	Fraser River at Hope, British Columbia.	78,300	95,300	226,000	190	-17	205,000	132,000	31

[1] Adjusted.

[2] Records furnished by Corps of Engineers.

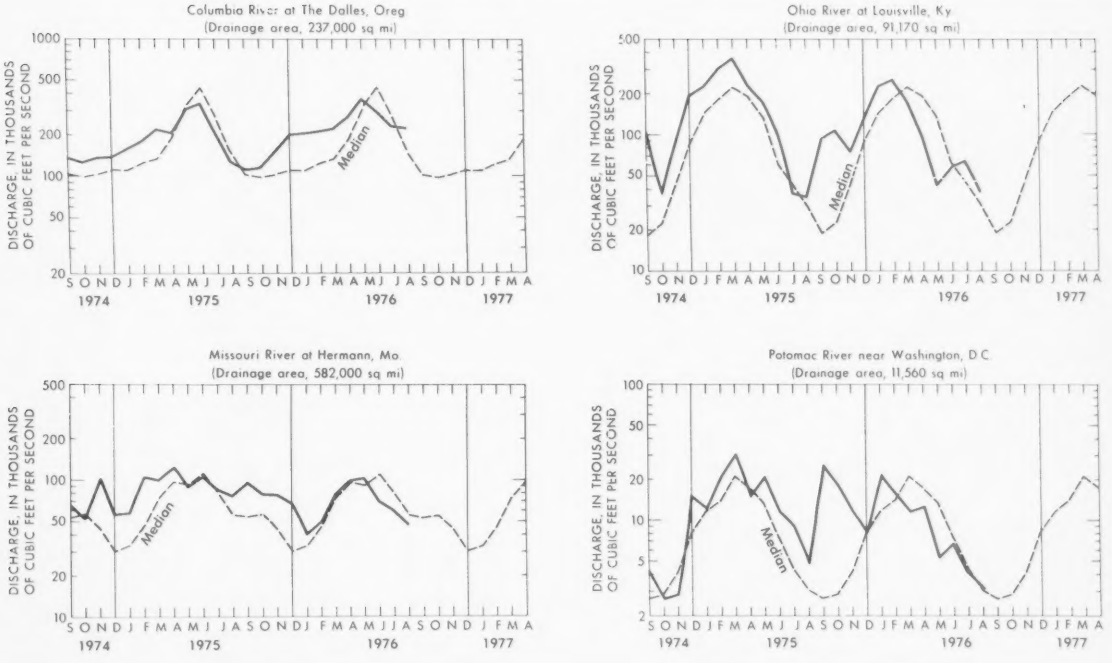
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.

[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

[5] Discharge (unadjusted) determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

HYDROGRAPHS OF FOUR LARGE RIVERS


Columbia River at The Dalles, Oreg.
(Drainage area, 237,000 sq mi)
Ohio River at Louisville, Ky.
(Drainage area, 91,170 sq mi)
Missouri River at Hermann, Mo.
(Drainage area, 582,000 sq mi)
Potomac River near Washington, D.C.
(Drainage area, 11,560 sq mi)
DISCHARGE, IN THOUSANDS OF CUBIC FEET PER SECOND
Median
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A
1974
1975
1976
1977

WATER RESOURCES REVIEW

AUGUST 1976

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EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for August based on 22 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for August 1976 is compared with flow for August in the 30-year reference period 1931–60 or 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for August is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range.* In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the August flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of August. Water level in each key observation well is compared with average level for the end of August determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of July to the end of August.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

ARTIFICIAL RECHARGE THROUGH A WELL IN FISSURED CARBONATE ROCK, WEST ST. PAUL, MINNESOTA

The abstract and graph below are from the report, *Artificial recharge through a well in fissured carbonate rock, West St. Paul, Minnesota*, by Harold O. Reeder, Warren W. Wood, Harry G. Ehrlich, and Ren Jen Sun: U.S. Geological Survey Water-Supply Paper 2004, 80 pages, 1976; describing an experiment and related tests in which treated water was injected into a fissured carbonate rock aquifer overlying a sandstone aquifer. The report may be purchased for $1.65 from Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 (check or money order payable to U.S. Geological Survey); or from Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (GPO Stock Number 024-001-02790-9), payable to Superintendent of Documents.

ABSTRACT

The Prairie du Chien Group was injected with 2,754,000 gallons (368,200 cubic feet, or 10,430 cubic meters) of municipally treated water at about 100 gallons per minute (13.4 cubic feet per minute), or 6.3 liters per second, for 20 days (fig. 1). The injection-pipe system was designed to utilize pipe friction rather than a remote-controlled valve in the well to maintain positive pressure and eliminate air entrainment in the injection water and the escape of dissolved gasses from the water. During the 20-day injection period the temperature of the injection water declined gradually from 15.0° to 11.2°C (fig. 1), and the flow rate decreased from 108 to 90 gallons per minute (6.8 to 5.7 liters per second).

Analyses of test data were, in some instances, based upon hydrologic judgment as well as observations. Results of aquifer tests before and after injections indicated that the transmissivity had decreased 18 percent during the intervening injection periods; however, the specific capacity remained the same, indicating no change in transmissivity during pumping. Analysis of water-level changes in observation wells during injection indicated a reduction in transmissivity of more than 50 percent; however, the specific capacity of the injection well decreased only about 5 percent during injection.

A comparison of water-level changes with the discharge or recharge rates of the three tests showed that the water-level changes in the two observation wells tapping the Prairie du Chien Group during the injection test were greater than those projected from the two aquifer pumping tests. The deviations in the water-level changes and in the analysis of aquifer-test data indicate that the methods used to analyze data from these wells may not be wholly applicable, inasmuch as anisotropic and nonhomogeneous conditions prevail in at least the Prairie du Chien part of the aquifer.

The native water and the injected water averaged 0.8 and 25 milligrams per liter chloride, respectively. The chloride, utilized as a tracer, showed that the injected water was detected only in the lower part of the nearest observation well, 99 feet (30.2 meters) from the injection well. The chemistry of the water and the rock formation showed little liklihood of plugging of the recharge well by chemical precipitation. Microbiological phenomena apparently did not become a significant factor in the recharge test.

The hydraulic gradient of the aquifer in October and December 1971 (before and after injection) was estimated to be N. 36° E., 0.0013, and N. 39° E., 0.0012, respectively, on the basis of measurements of water levels in the three wells in the Prairie du Chien Group. The single-well tracer-dilution method of calculation showed a hydraulic gradient of 0.0016. A longitudinal dispersivity of 280 feet (85 meters) was calculated. Such a value of dispersivity is typical of fractured reservoirs and shows that the Prairie du Chien Group is a heterogeneous aquifer.

The injection test demonstrated that it is hydrologically feasible to recharge the Prairie du Chien Group and the Jordan Sandstone artificially through wells completed in the Prairie du Chien Group. The fissures in the Prairie du Chien Group act as conduits through which water spreads. The water passes into the Jordan Sandstone from the Prairie du Chien over a larger area than it would if it were injected directly into the Jordan.

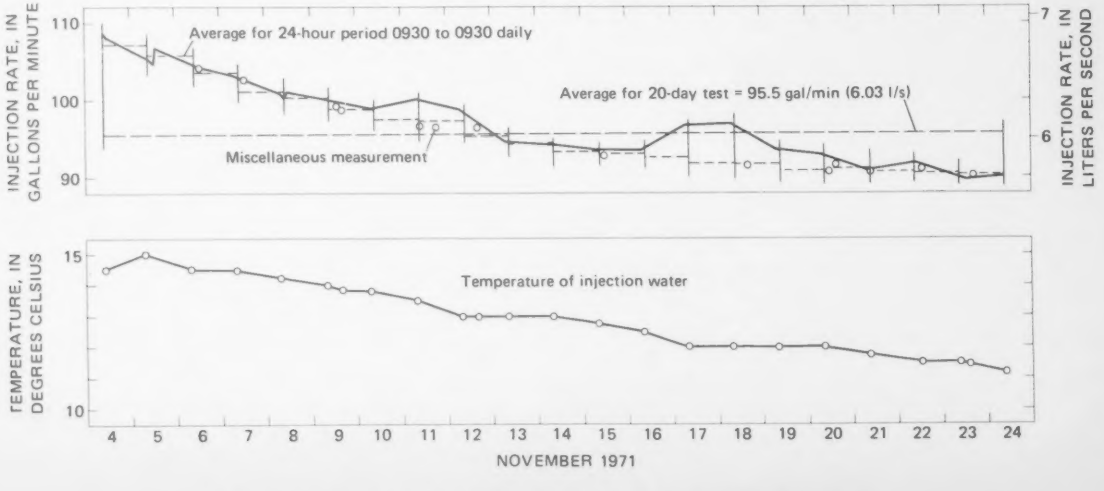
INJECTION RATE, IN GALLONS PER MINUTE
110
100
90
Average for 24-hour period 0930 to 0930 daily
Average for 20-day test = 95.5 gal/min (6.03 l/s)
Miscellaneous measurement
7
6
INJECTION RATE, IN LITERS PER SECOND
TEMPERATURE, IN DEGREES CELSIUS
15
10
Temperature of injection water
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
NOVEMBER 1971

Figure 1.—Injection rate and temperature of injection water during injection test.

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